



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/718,413	11/24/2000	Charles Stephen Wiles	1263.1797	1602
5514	7590	03/29/2004	EXAMINER	
FITZPATRICK CELLA HARPER & SCINTO			CARTER, AARON W	
30 ROCKEFELLER PLAZA			ART UNIT	
NEW YORK, NY 10112			PAPER NUMBER	

2625

DATE MAILED: 03/29/2004

9

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/718,413

Applicant(s)

WILES ET AL.

Examiner

Aaron W Carter

Art Unit

2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-118 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20-23, 49-52, 81, 83-85, 87-95 and 101-103 is/are allowed.
- 6) ☒ Claim(s) 1-19, 24, 25, 28-48, 53, 56-64, 66, 68-80, 82, 86, 96-100, 104 and 109-118 is/are rejected.
- 7) ☒ Claim(s) 26, 54 and 105-108 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 November 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 4,7,07/09/2001
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Specification***

1. The abstract of the disclosure is objected to because it is longer than 25 lines or 150 words. Correction is required. See MPEP § 608.01(b).

2. The disclosure is objected to because of the following informalities:

Each section is not clearly labeled, for example no distinction between the Background and Summary.

Appropriate correction is required.

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### ***Claim Objections***

4. Claims 60 and 63 are objected to because of the following informalities:

As to claims 60 and 63 are dependent on one independent claim while refer to limitation of another independent claim. Please delete references to claims 1 and 30 and physically include limitation that are intended to be in claims 60 and 63.

Appropriate correction is required.

***Claim Rejections - 35 USC § 101***

5. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 27, 55, 65 and 67 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

As to claim 27, the invention discloses non-functional descriptive material; please refer to the phrase on line 2 stating, "...outputting a signal carrying data defining..." A signal, per se, which is nothing more than an abstract idea, in order for the functionality of a data signal to be realized, it must be tangibly embodied on a "computer readable medium". Examiner suggests canceling claim 27.

As to claims 65 and 67, the invention discloses non-functional descriptive material; please refer to the phrase on line 1 stating, "A signal carrying processor implementable instructions". A signal, per se, which is nothing more than an abstract idea, in order for the functionality of a data signal to be realized, it must be tangibly embodied on a "computer readable medium". Examiner suggests canceling claims 65 and 67.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Art Unit: 2625

6. Claim 24 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 24 recites the limitation "when the derived value for a voxel" in lines 12-13. There is insufficient antecedent basis for this limitation in the claim.

***Claim Rejections - 35 USC § 102***

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1-19, 25, 28-48, 53, 56-64, 66, 68-80, 82, 86, 96-100, 104 and 109-118 are rejected under 35 U.S.C. 102(b) as being anticipated by an article entitled "Rapid Octree Construction from Image Sequences" by Szeliski.

As to claim 1, Szeliski discloses a method of operating an image processing apparatus for processing image data representing images of an object taken from a plurality of different camera positions, the method comprising the steps of:

(a) determining the viewing volume for each camera position (page 23, column 2, lines 20-22 and 34-41, wherein for each viewpoint of the camera a conic volume is determined);

Art Unit: 2625

(b) determining the volume bounded by the intersection of the viewing volumes (page 23, column 2, lines 20-23 and 34-41, wherein the conic volumes are intersected as each image arrives); and

(c) setting the bounded volume as an initial space for use in deriving a representation of the three-dimensional surface of the object using said images (page 23, column 1, section 1, lines 1-6 and page 24, Section 2, lines 1-3).

As to claim 2, Szeliski discloses a method according to claim 1, further comprising the step:

(d) of dividing the bounded volume into voxels to form an initial voxel space (page 24, Section 2, lines 1-3 and page 24, section 2, column 2, lines 1-4, wherein the initial voxel space consists of a single large cube).

As to claim 3, Szeliski discloses a method according to claim 2, further comprising:

(e) determining, for each voxel that is not occluded by another voxel, the area corresponding to that voxel in each image in which that voxel is visible (page 24, section 3, paragraph 2, lines 10-13);

(f) comparing characteristics of each of the image areas corresponding to the same voxel (page 25, section 4);

(g) removing a voxel in response to the characteristics of the image areas corresponding to that voxel being inconsistent (page 24, section 2, paragraph 1 and section 3, paragraph 1,

Art Unit: 2625

wherein the white cubes correspond to inconsistent voxel and they are remove after each revolution); and

(h) repeating steps (e) to (g) until all non-occluded voxels having inconsistent characteristics have been removed (page 24, section 3, paragraph 1, wherein after each revolution each voxel is subdivided in to 8 voxel, wherein during the course of the revolution the cubes are designated as being white and are removed at the end of the revolution).

As to claim 4, please refer to rejections made for claims 1-3 above.

As to claim 5, Szeliski discloses a method according to claim 1, wherein the step of determining the viewing volume for a camera position comprises determining the viewing volume using data representing a camera focal point and a camera imaging area for that camera position (page 28, section 7.1).

As to claim 6, Szeliski discloses a method according to claim 5, wherein the step of determining the viewing volume includes projecting straight lines from the focal point through points on the boundary of the imaging area (page 28, section 7.1).

As to claim 7, Szeliski discloses a method according to claim 1, wherein the step of defining the intersection of the viewing volumes comprises:

(i) determining an initial intersection of the viewing volumes of first and second camera positions (page 24, section 3, paragraph 1, wherein a sequence of viewing volumes are compared against the proceeding one to construct a 3D model of the object being viewed);

(ii) determining the intersection of that intersection with another viewing volume and setting that intersection as the current intersection (page 24, section 3, paragraph 2, wherein with each image the 3D model is carved away); and

(iii) repeating steps (i) and (ii) until the viewing volumes for all camera positions have been considered (page 24, section 3, paragraph 1, wherein during one revolution each camera position is considered).

As to claim 8-15, please refer to rejections made for claims 1-3 and 5-7 above because no new limitations have been presented in claims 8-15 that have not already been addressed.

As to claim 16, Szeliski discloses, in an image processing apparatus having a processor for processing image data representing images of an object taken from a plurality of different camera positions, a method of processing image data to derive a representation of a three-dimensional surface of the object, the method comprising the steps of:

(a) defining an initial volume containing the object surface as an initial space formed of voxels (page 24, Section 2, lines 1-3 and page 24, section 2, column 2, lines 1-4, wherein the initial voxel space consists of a single large cube);



Art Unit: 2625

(b) accessing data representing images of the object recorded at different camera positions with respect to the object (page 24, section 3, paragraph 1, wherein a sequence of silhouettes corresponds to images at different camera positions);

(c) checking to see if a voxel meets at least one criterion by projecting that voxel into at least one of the images (page 24, section 3, paragraph 2 and page 25, section 4, wherein criterion corresponds to determining wherein voxel is inside or outside the silhouette);

(d) if the voxel does not meet said at least one criterion, dividing the voxel into subsidiary voxels (page 24, section 2, paragraph 1, lines 1-3 and page 24 and 25, section 3, wherein if the voxel is gray it is dividing into more voxel); and

(e) then checking to see if the subsidiary voxels meets at least one criterion by projecting the subsidiary voxels into at least one of the images (page 24 and 25, section 3, wherein once the voxels are divided the processes starts over in an effort to refine the voxels even more).

As to claim 17, Szeliski discloses a method according to claim 16, further comprising deciding that a sub-voxel does not form part of the three-dimensional surface and so should be removed if the sub-voxel does not meets said at least one criterion (page 24, section 2, paragraph 1, lines 1-3 and page 24 and 25, section 3, wherein if the voxel is not part of the 3D surface it is deemed a white voxel and removed)

As to claim 18, Szeliski discloses a method according to claim 16, further comprising repeating steps c, d and e for any sub-voxel that does not meet said at least one criterion (page 24

Art Unit: 2625

and 25, section 3, wherein once the voxels are divided the processes starts over in an effort to refine the voxels even more).

As to claim 19, Szeliski discloses a method according to claim 16, wherein the at least one criterion comprises any one or more of the following:

- 1) the colour variance in a pixel patch to which the voxel projects in an image has a value lower than a predetermined value;
- 2) the difference in colour or average colour between pixel patches to which the voxel projects in different images has a standard deviation less than a predetermined value; and
- 3) the voxel is not partially occluded by a voxel or subsidiary voxels of smaller size than the voxel (page 24 and 25, section 3, wherein the voxel will only be designated white if it is not at least partially occluded by another voxel of any size, it would be considered gray if is occluded).

As to claim 25, Szeliski discloses a method according to claim 4, wherein the step of determining the area corresponding to a voxel in an image comprises projecting the voxel into each image (page 24, section 3, paragraph 2, lines 10-13).

As to claim 28, Szeliski discloses a method according to claim 4, which further comprises providing a computer storage medium storing data defining the initial space or the voxel representation of the 3D object surface (page 24, column 1, lines 4-5).

As to claim 29, Szeliski discloses a method according to claim 4, further comprising generating texture data for rendering onto the representation of the 3D object surfaces (page 31, section 10, paragraph 3).

As to claim 30-36, please refer to rejections made for claims 1-7, respectively, above.

As to claim 37-44, please refer to rejections made for claims 1-3 and 5-7 above because no new limitations have been presented in claims 37-44 that have not already been addressed.

As to claims 45-48, please refer to rejections made for claims 16-19, respectively, above.

As to claim 53, please refer to rejections made for claim 25 above.

As to claim 56, please refer to rejections made for claim 28 above.

As to claim 57, please refer to rejections made for claim 29 above.

As to claims 58, 59, 61 and 62, Szeliski discloses a method according to claim 16, which further comprises:

Accessing data representing a further image of the object recorded at different camera position; and then repeating steps of claim 16 using that further image (page 24, section 3, paragraph 2, lines 10-13).

As to claim 60 and 63, please refer to rejections made for claim 1 above.

As to claim 64 and 66, Szeliski discloses a storage medium carrying processor implementable instructions for causing processing means to carry out a method in accordance

Art Unit: 2625

with claim 1 or 30 (page 23, Abstract, lines 8-15, wherein computation inherently means that the invention includes a storage medium carrying processor implementable instructions).

As to claim 68-80, 82, 86, 96-100 and 109-118, please refer to rejections made for claims 1-3, 5-7, 16-19, 25 and 28 above because no new limitation have been presented in the claims that have not already been addressed.

As to claim 104, please refer to rejections made for claim 25 above.

***Allowable Subject Matter***

9. Claims 20-23, 49-52, 81, 83-85, 87-95 and 101-103 are allowed.
10. Claims 26, 54 and 105-108 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
11. Claim 24 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.
12. The following is an examiner's statement of reasons for allowance: As to claims 20, 49, 81, 83-85, 87-89 91, 93, 95, 101 and 103 none of the prior art teach or fairly suggests the limitations of deriving from the compared characteristics a value representing the degree of any

Art Unit: 2625

inconsistency between the characteristics of the image areas corresponding to the given voxel and sub-dividing a voxel into subsidiary voxels in response to the derived value exceeding a threshold value and repeating steps (c) to (e) for each subsidiary voxel, in combination with the other limitations of the claims. As to claims 23, 51, 90, 92, 94 and 102 none of the prior art teach or fairly suggests the limitation of determining a colour space value for each pixel of each area where each colour space value encompasses a range of pixel colour values, comparing the colour space values for each of the image areas corresponding to the same voxel, and removing the voxel only if the image areas do not share at least one colour space value. However, US Patent 6,363,170 to Seitz et al. ("Seitz") discloses deriving a color value for voxels represented in each image, determining a degree of inconsistency between corresponding color values of images and based on a threshold deciding whether or not to add the voxel to the final 3D representation, Seitz does not teach or fairly suggest that based on the result of comparing the value with the threshold that the voxel is then divided into subsidiary voxel or completely removed for the already in place 3D representation of the object.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Conclusion***

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US Patent 5,917,937 to Szeliski et al. discloses determining a volume boundary through viewpoint intersection.

US Patent 6,373,977 to Culbertson discloses determining a volume boundary through viewpoint intersection and discusses how to handle color.

US Patent 6,351,572 to Dufour discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

US Patent 6,407,738 to Wakabayashi discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

US Patent 6,563,499 to Waupotitsch et al. discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

US Patent 6,574,360 to Berdardini et al. discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

US Patent 5,189,626 to Colburn discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

US Patent 6,088,035 to Sudarsky et al. discloses determining a volume boundary through viewpoint intersection and octree reconstruction.

“How Far 3D Shapes Can Be Understood from 2D Silhouettes” by Laurentini, Aldo discloses determining a volume boundary through viewpoint intersection.

“3D Shape Reconstruction using Volume Intersection Techniques” by Carr et al. discloses determining a volume boundary through viewpoint intersection.

Art Unit: 2625

“Inferring the Shape of the Real Object from the Object Reconstructed by Volume Intersection” by Laurentini, Aldo discloses determining a volume boundary through viewpoint intersection.

“The Visual Hull Concept for Silhouette-Based Image Understanding” by Laurentini, Aldo discloses determining a volume boundary through viewpoint intersection.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aaron W Carter whose telephone number is (703) 306-4060. The examiner can normally be reached on 7am - 3:30 am (Mon. - Fri.).

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Bhavesh Mehta can be reached on (703) 308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AWC  
awc



**BHAVESH M. MEHTA**  
**SUPERVISORY PATENT EXAMINER**  
**TECHNOLOGY CENTER 2600**